Technical Note on the spraying of Bacillus thuringiensis kurstaki for the suppression of spruce budworm larvae (Choristoneura fumiferana (Clemens, 1865)) in selected areas of Nova Scotia, 1980.

LEGISLATIVE LIBRARY
TORONTO
MAR 10 1981
RECEIVED

Introduction

This report was prepared to provide a synopsis of the results of spraying with a microbiological biocide (*Bacillus thuringiensis kurstaki*) *B.t.k.* to reduce population densities of spruce budworm in selected high value spruce and/or fir stands in Nova Scotia in 1980.

Objective

The objective of the 1980 *B.t.k.* spray project was to maintain fifty percent or more of the current foliage on spruce and/or fir trees in the treatment areas.

Weather

The predominant factor affecting the conduct of the *B.t.k.* project was weather. This year very unusual weather conditions prevailed with the coldest spring in a century. This cool damp weather retarded spruce budworm larval development, growth of the spruce and fir shoots, and spraying by two weeks.

Area Treated

The total area treated was 25 670 ha, 17 509.3 ha in the Cape Breton Highlands and 8 160.7 ha on the Mainland. The biocide used was a commercial preparation of *B.t.k.* known as Thuricide 16B. It was at an application rate of 20 BIU·ha^{-1} in 9.47 l·ha^{-1} of formulation.

Results

In general, the results of the 1980 *B.t.k.* project can be considered as acceptable, with some minor exceptions. The percent foliage protection varied from 56.7 to 79.3 for balsam on Cape Breton. The

percent larval mortality ranged from 3.1 to 62.0 for population densities varying from 25 to 50 larvae per 45 cm branch. Rain washed the biocide from the trees on Round Mountain. The percent foliage protection varied from 64.3 to 88.2 percent for spruce and was 73 percent for fir in the Economy treatment area. The percent larval mortality varied from 88.9 to 92.6 for spruce and was 84.6 for fir in the Economy treatment area, for population densities of 5 to 12 larvae per 45 cm branch (Table 1). Spraying began on June 11 and ended on July 3, 1980.

Expenditures

The total expenditure of the B.t.k. project to September 30, 1980 was $1,175,562.52. The cost per hectare was $45.79 and the cost per hectare flown was $41.09 (Table 2).

Summary

In summary, ninety percent of the area treated received acceptable foliage protection of maintaining 50 percent or more of the current foliage.

Thomas D. Smith

By Dr. T. D. Smith

N. S. Department of
Lands and Forests

December, 1980

Table 6. Percent foliage protection and percent larval mortality of spruce budworm larvae (Choristoneura fumiferana (Clemens, 1865)) obtained by aerially applying a microbiological biocide (Bacillus thuringiensis kurstaki)(20 BIU ha^{-1}) in selected areas of Nova Scotia, June and July, 1980.

Name	No.	Cover[1] Type	Function	Area (ha)	Number of Applications (20 BIU ha^{-1})	Area Flown	Larval Instar Treated	Mean Number of Larvae per 45 cm branch	Foliage Protection %	Foliage Protection Acceptable	% Larval Mortality
Cape Breton											
Miners Road	1	wS	2	136.0	3	402.0	5 - 6	ND[6]	ND[6]	No	ND[6]
Kelly Road	2	bS(bF)	2	115.0	2	230.0	5 - 6	ND[6]	ND[6]	Yes	ND[6]
Bell Lake	3	bF	1	3 964.9	1	3 964.9	3 - 4	55.7	56.7	Yes	ND[6]
Crowdis Mountain	4	bF	1	3 074.0	1	3 074.0	3 - 4	27.4	79.3	Yes	11.7
Round Mountain	5	bF	1	2 221.4	1	2 221.4	6	42.0	0.0	No	(87.0)
Cairloch Mountain	6	bF	1	7 882.0	1	882.0	3 - 4	24.9	60.2	Yes	62.0
Cairloch Road	7A	wS	2	65.0	2	115.2	5 - 6	ND[6]	ND[6]	Yes	ND[6]
Hume Road	7B	bS	2	25.0	3	68.7	5 - 6	ND[6]	ND[6]	Yes	ND[6]
Muskrat Brook	8	bS	2	25.0	3	71.0	5 - 6	ND	74[7]	Yes	60.1[7]
Subtotal Cape Breton				17 509.3		18 029.2					
Mainland											
Advocate	9	rS[1]	1	1 009.9	1	1 009.9	5 - 6	5.7	88.2	Yes	92.6
Shulie	10	rS	1	1 458.0	1	1 458.0	5 - 6	6.8	86.4	Yes	92.6
Moose River	11	rS	1	3 204.9	1	3 204.9	5 - 6	7.1	82.7	Yes	88.9
Economy	12	rS & bF	1	2 460.9	2	4 877.5					
balsam fir		bF					3 - 4	23.3	73.0	Yes	84.6
spruce		rS					5 - 6	16.4	64.3	Yes	88.9
Subtotal Mainland				8 160.7		10 577.3					
TOTAL AREA				25 670.0		28 606.5					

1. Cover type based on Quebec system, wS - White spruce, bF - balsam fir, rS - red spruce, species complex (red + white + black spruce).
2. 2 is cone production area, 1 is foliage protection area.
3. Determined from navigator reports.
4. Spray areas opened at 50 percent bud flare.
5. Chi-square, Abbotts formula.
6. Quantitative data not collected on areas less than 150 ha.
7. Determined from laboratory rearing records.

Table 2. Expenditures of the operational project to suppress spruce budworm larvae (Choristoneura fumiferana, (Clemens, 1865)) in selected areas by aerially applying Bacillus thuringiensis kurstaki (20 BIU·ha^{-1}) Nova Scotia, September 30, 1980.

EXPENDITURES				
Category	$	%	$·ha^{-1} Area	Flown
Salaries	181,069.29	15.40	7.05	6.33
Travel	11,404.55	0.97	0.44	0.40
Special Services	19,210.41	1.63	0.75	0.67
Supplies & Services	839,795.65	71.44	32.72	29.35
Biocide	381,737.91	32.47	14.87	13.34
Aircraft	355,017.68	30.20	13.83	12.41
Lodging	54,460.38	4.63	2.12	1.90
Rentals	18,244.73	1.55	0.71	0.63
Trucking	30,334.95	2.58	1.18	1.06
Equipment	102,531.46	8.72	3.99	3.58
Others	21,551.16	1.83	0.84	0.75
TOTAL	1,175,562.52	100.00	45.79	41.09
Total Area (ha)	--	--	25670.0	28606.5

DISCLAIMER STATEMENTS

The use of trade, firm, or corporation names is for the information and convenience of the reader. Such use does not constitute an official evaluation, conclusion, recommendation, endorsement or approval of any product or service to the exclusion of others which may be suitable.

This publication reports research involving pesticides. It does not contain recommendations for their use, nor does it imply that the used discussed here have been registered. All uses of pesticides must be registered by appropriate Provincial and/or Federal agencies before they can be recommended.

MARITIMES FOREST RESEARCH CENTRE
TECHNICAL NOTE NO. 17

CONDITION OF BALSAM FIR ON RESEARCH PLOTS ON CAPE BRETON ISLAND IN THE FALL OF 1980

High populations of the spruce budworm caused severe defoliation of balsam fir on permanent sample plots on Cape Breton Island in 1980. Current defoliation ranged from 86-100% on 14 of 15 plots on the Highlands and on all 5 Lowland plots. Defoliation on one Highland plot was less than 5%. Shoot and bud destruction was common on 11 of the 15 Highland plots and 4 of 5 Lowland plots. As a result of the high budworm numbers many of the 1980 buds were mined in the early larval stages and back feeding was significant during the later larval stages.

Data from the plots (Table 1) shows that 47% of the fir on the Highlands, 10 cm DBH and over, is dead and that 10.9% of this loss occurred in 1980. Mortality was higher than predicted in 1979. In past years most of the mortality has occurred in trees with greater than 90% total defoliation. However, in 1980 47% of the trees that died were in the 75-90% total defoliation class (Table 2). Total defoliation of almost all surviving balsam fir is greater than 50%. Expected to die in 1981 is 5.4% which is presently over 90% defoliated and an additional 6% of the balsam fir in the 75-90% total defoliation class.

In the Lowlands, mortality increased from 4.7% of the trees 10 cm DBH and over, in 1979 to 24.5% in 1980 bringing the total mortality of balsam fir to 40.8%. Many of the trees that died had high populations of the balsam fir bark weevil. Weevils usually attack weakened, suppressed, and decadent trees but when populations are high as a result of abundant suitable breeding material insects may attack healthy trees. The larvae mine under the bark and form winding galleries gradually increasing in size and extending through the inner bark. Extensive mining by the larvae can result in the girdling of the tree. In one plot alone, 7 of 8 trees that died had extensive weevil activity. These trees were living in the fall of

NURSERIES
PLANTATIONS
SILVICULTURE
UTILIZATION
ECONOMICS
TREE IMPROVEMENT
INSECTS AND DISEASES

CANADIAN FORESTRY SERVICE
MARITIMES FOREST RESEARCH CENTRE
Box 4000, FREDERICTON, N.B. E3B 5P7 Tel 506-452-3500
Box 667, TRURO, N.S. B2N 5E5 Tel 902-895-1621
ENVIRONMENT CANADA

MARITIMES

1979 and were dead by the fall of 1980. At the time of observation only empty pupal cells were found suggesting that the insect was active in the trees during 1979. Expected to die in 1981 is 11.3% which is presently over 90% defoliated in addition to those which may be killed by the weevil.

Table 1. Condition of balsam fir on permanent plots on Cape Breton Island expressed as a percent of stems 10 cm DBH and over

	Highlands					Lowlands				
Tree Condition	1976	1977	1978	1979	1980	1976	1977	1978	1979	1980
Dead										
1 yr. or less	1.8	11.5	10.0	7.8	10.9	1.2	5.3	3.4	4.7	24.5
1 yr to 2 yrs.	-	-	14.7	10.3	9.3	-	-	7.4	2.6	5.0
2 yrs or more	4.5	4.9	7.0	20.1	26.4	4.3	3.5	3.7	10.9	10.7
Blowdown since 1978				2.0	3.4				0	0.6
Total	6.3	16.4	31.7	40.2	50.0	5.5	8.8	14.5	18.2	40.8
Defoliated										
Current Foliage only	0	0	0	0	0	2.7	0	0	0	0
Less than 50%	27.2	20.7	14.4	3.4	0.8	83.6	40.9	44.9	21.8	1.9
50-90%	55.4	53.0	43.1	49.5	43.8	3.9	49.7	40.1	57.8	45.9
more than 90%	11.1	9.9	10.8	6.9	5.4	3.2	0.6	0.4	2.2	11.3

Table 2. Percent mortality of balsam fir on Cape Breton Highlands in each defoliation class from 1977 to 1980.

Date	Defoliation Class (% total defoliation)				
	51-75	76-90	91-100	% balsam fir mortality	Total Mortality
1977	0	12.2	87.8	11.5	16.4
1978	1.1	25.0	73.9	10.0	31.7
1979	5.4	28.2	66.7	7.8	38.2
1980	14.1	46.7	39.1	10.9	46.6

-D. P. Ostaff
Forest Insect and Disease Survey

October, 1980

MARITIMES FOREST RESEARCH CENTRE

TECHNICAL NOTE NO. 19

SPRUCE BUDWORM INFESTATIONS IN NOVA SCOTIA IN 1980 AND A FORECAST FOR 1981

This is a synopsis of the analysis of spruce budworm surveys conducted in 1980. These surveys were a joint effort of the Nova Scotia Department of Lands and Forests and the Maritimes Forest Research Centre of Environment Canada and as such reflect efforts by the Province to become more involved in these surveys and to gain practical field experience in their conduct. The two surveys reported on herein are the aerial survey for spruce budworm defoliation which is carried out to determine the extent and severity of spruce budworm feeding, and the egg-mass survey which is used to forecast infestations for the coming year. The results of a damage appraisal survey to estimate loss of timber are not included but have already been presented separately under Technical Note No. 17.

Aerial Survey for Defoliation

The accompanying map (Fig. 1) shows a dramatic increase in the extent and severity of budworm defoliation in 1980 (some 1.4 million hectares of defoliation compared to 1.1 million hectares in 1979). This increase in acreage of defoliation was greatest on the mainland in all three spheres of spruce budworm activity (Table 1). The area of defoliation increased on Cape Breton Island as well and some 361 000 hectares were severely attacked in 1980 compared to 257 000 hectares in 1979. This general increase is not surprising and adequately reflects predictions made from 1979 egg-mass surveys.

NURSERIES

PLANTATIONS

SILVICULTURE

UTILIZATION

ECONOMICS

TREE IMPROVEMENT

INSECTS AND DISEASES

CANADIAN FORESTRY SERVICE
MARITIMES FOREST RESEARCH CENTRE
Box 4000, FREDERICTON, N.B. E3B 5P7 Tel 506-452-3500
Box 667, TRURO, N.S. B2N 5E5 Tel 902-895-1621

ENVIRONMENT CANADA

MARITIMES

Forecast of Infestations for 1981

In 1980 some 222 samples were processed for counts of spruce budworm egg-masses (Table 2). They were received from all counties except Queens. Counts of budworm egg-masses per unit area of host tree foliage are used to forecast population levels and the probable resultant damage for the coming year, and to show population trends over time (Fig. 2).

For Cape Breton Island, forecasts of infestations are still high for 1981. Infestations are similar to those recorded in 1979 except in Victoria County where infestations are substantially lower than a year ago. However, even in Victoria County there is a very large area of high infestation. In general, severe defoliation will likely occur over a large portion of the forest of Cape Breton Island in 1981.

In Cumberland and Colchester counties egg-mass densities (by county-wide averages) are lower in 1980 than in 1979 but large areas of high infestation were detected in the Cumberland Peninsula. The infestation here has persisted since 1970.

Egg-mass infestations decreased in Pictou County but increased considerably in Antigonish County. Defoliation will probably be noticeable but of a very patchy nature in 1981.

In the Annapolis Valley egg-mass infestations have increased for the fourth consecutive year both in severity and area affected.

Generally, the infestation in Nova Scotia has shown considerable resilience to persist and cause extensive damage. However it should be viewed in the context of the overall infestation affecting approximately 40 500 000 hectares of forest from Manitoba to Newfoundland. No significant downturn in infestation levels can be expected in Nova Scotia until there is a general and widespread downturn in the epidemic as a whole. As yet this has not happened.

- E. G. Kettela
Technical and Information Services

November, 1980

Table 1. Summary of areas of spruce budworm defoliation* in Nova Scotia from 1978 to 1980.

Sector of province	Year	Defoliation categories (hectares x 1000)				Total
		light	moderate	variable	severe	
Mainland						
Cumberland	1978	3.2	20.3	0	74.5	98.0
Colchester	1979	3.6	17.8	0	77.0	98.4
	1980	3.2	66.0	45.8	102.1	217.1
Northumberland	1978	10.9	11.7	0	1.2	23.8
Coast	1979	31.6	8.9	0	15.8	56.3
	1980	13.8	1.2	56.3	7.3	78.6
Annapolis	1978	0	0	0	0	0.0
Valley	1979	20.7	11.3	0	9.7	41.7
	1980	40.1	36.0	0	21.5	97.6
Cape Breton	1978	0	68.9	203.3	376.7	648.9
Island	1979	164.4	129.6	339.4	256.8	890.2
	1980	47.4	121.1	456.8	361.3	986.6

Total area of all categories of defoliation (thousands of hectares)	1978	1979	1980
	771	1 087	1 380

*from maps developed from aerial surveys of spruce budworm defoliation.

Table 2. Average spruce budworm egg-mass infestation counts per $10m^2$ in Nova Scotia, by county from 1974 to 1980.

County	Year						
	1974	1975	1976	1977	1978	1979	1980
Richmond	125	203	430	649	364	403	423
Cape Breton	-	496	1608	524	437	349	378
Inverness	468	552	1319	758	389	316	308
Victoria	370	676	1832	771	435	647	258
Cumberland	293	263	191	71	218	307	235
Colchester	24	20	104	23	165	52	10
Pictou	-	23	29	125	140	214	116
Antigonish	204	135	196	182	252	65	136
Guysborough	0	0	6	78	-	8	0
Kings	14	12	12	25	73	183	245
Annapolis	19	16	18	27	121	165	224
Hants	36	11	6	6	0	19	61
Digby	12	6	11	20	-	3	86
Halifax	0	37	0	5	-	0	30
Lunenburg	0	6	0	6	9	16	10
Shelburne	0	3	0	12	-	8	28
Queens	0	3	4	4	0	0	-
Yarmouth	0	0	16	20	-	28	29

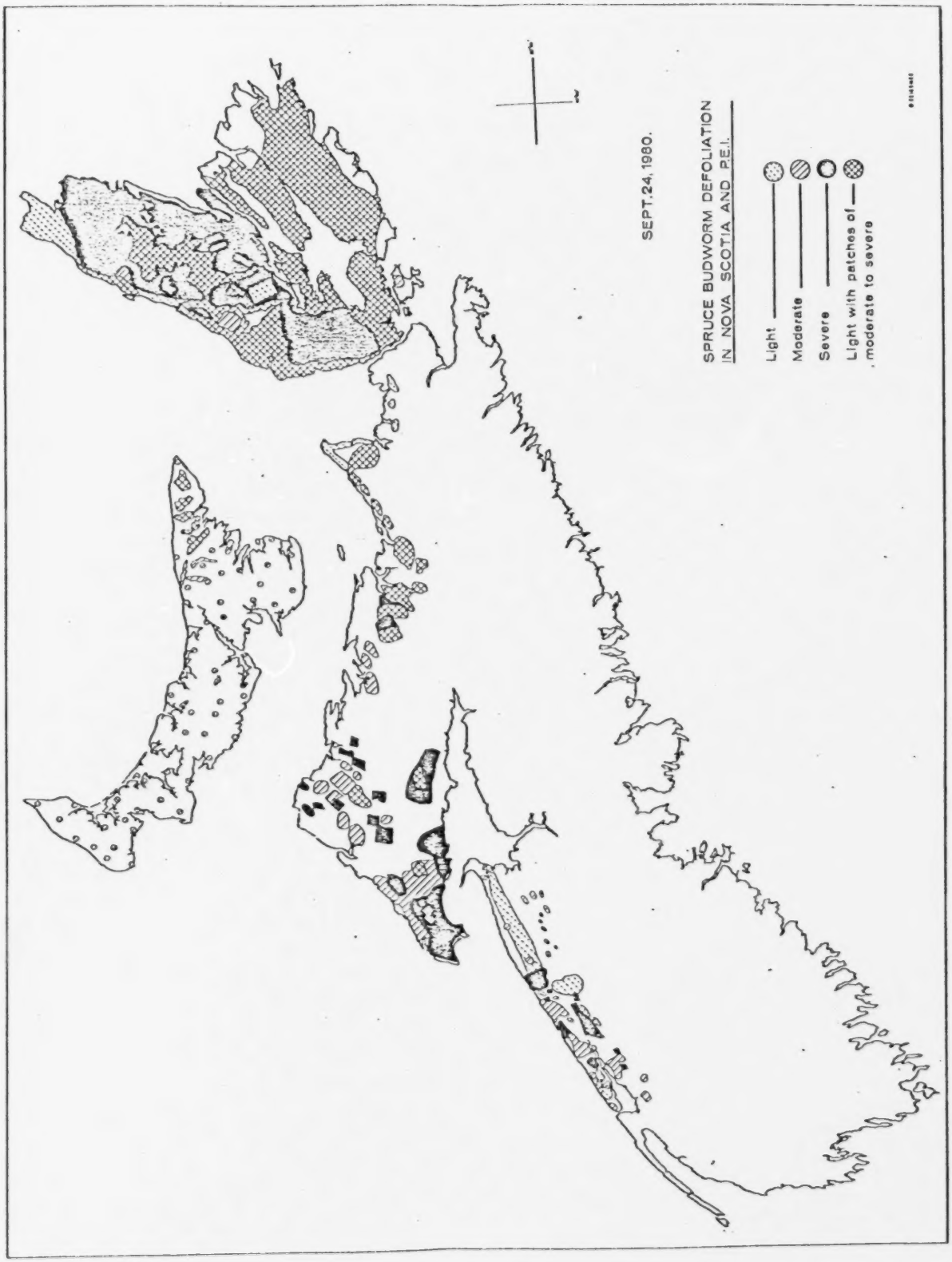

Figure 1. Map showing spruce budworm defoliation in Nova Scotia, 1980.

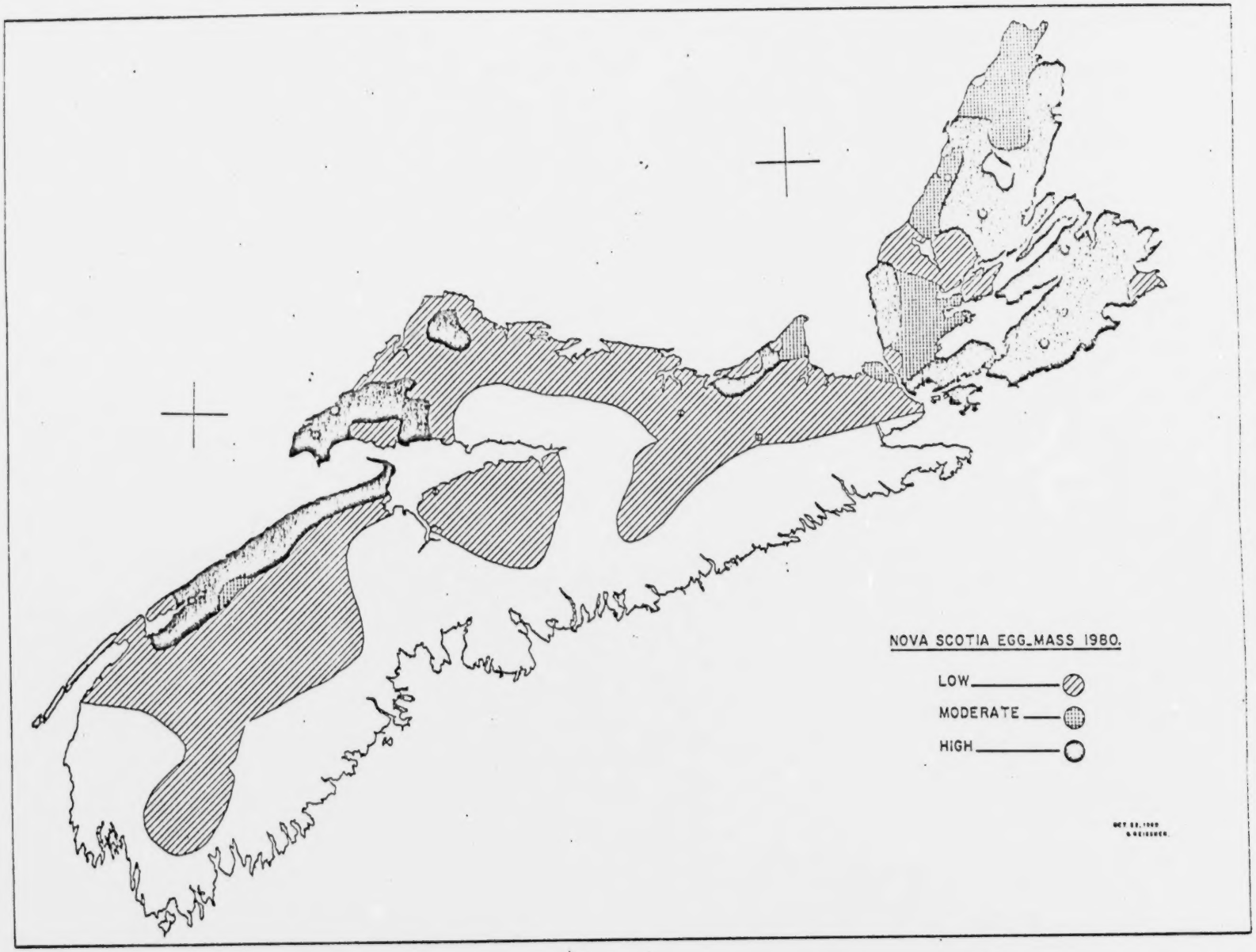

Figure 2. Spruce budworm eggmass defoliation in Nova Scotia, 1980.